Claims

1. Membrane electrode unit for membrane fuel cells, comprising an ion-conducting membrane, at least one anode electrode layer, at least one cathode electrode layer, at least one porous, water repellent gas diffusion layer mounted on the anode side and at least one porous, water repellent gas diffusion layer mounted on the cathode side, wherein
   - the total pore volume of the cathode gas diffusion layer is higher than the total pore volume of the anode gas diffusion layer ($V_{Cathode} > V_{Anode}$), and
   - the amount of water repellent agent in the anode and the cathode gas diffusion layer is in the range of 20 to 35% by weight (based on the total weight of the gas diffusion layer), and
   - the amount of water repellent agent in the anode gas diffusion layer is identical or higher than the amount of water repellent agent in the cathode gas diffusion layer ($WRA_{Anode} \geq WRA_{Kathode}$).

2. Membrane electrode unit according to Claim 1, wherein the the total pore volume of the gas diffusion layer on the cathode side ($V_{Cathode}$) is in the range from 1.0 to 2.5 ml/g and the total pore volume of the gas diffusion layer on the anode side (V_{Anode}) is in the range from 0.5 to 2.0 ml/g.

3. Membrane electrode unit according to Claim 1, wherein the water repellent agent comprises of fluorinated polymers such as PTFE, PVDF, and FEP and mixtures thereof.

4. Membrane electrode unit according to Claim 1, wherein the gas diffusion layers on the anode and/or the cathode side comprise a microlayer with

a layer thickness between 5 and 30 micron.

5. Membrane electrode unit according to Claim 1, wherein the ion-conducting membrane consists of proton-conducting polymer materials such as tetrafluoro-ethylene/fluorovinyl ether copolymers having acid functions, in particular sulphonic groups.

6. Membrane electrode unit according to Claim 1, wherein the electrode layers comprise of catalytically active, finely divided noble metals, such as, for example, platinum, palladium, ruthenium, gold or combinations thereof.

7. Membrane electrode unit according to Claim 1, furthermore comprising sealing materials and optionally reinforcing materials for gas-tight sealing on installation in membrane fuel cell stacks.

8. Membrane fuel cell stack, comprising membrane electrode units according to any one of Claims 1 to 6.

9. Process for operating a membrane fuel cell stack with dry, unhumidified operating gases, wherein the membrane fuel cell stack comprises the membrane electrode units according to any one of Claims 1 to 6.

10. Process for operating a membrane fuel cell stack according to claim 9, wherein the dry, unhumidified gases comprise of hydrogen, reformate gas, oxygen or air.